

## CHAPTER 7

### SECTION 5 CHOLINESTERASE TESTING PROGRAM

#### 7.5.1 PURPOSE

The cholinesterase health monitoring program is mandatory and prevents and/or reduces overexposure to cholinesterase inhibiting compounds such as carbamate and organophosphate pesticides.

#### 7.5.2 GENERAL

Cholinesterase is an enzyme essential to the body's central nervous system. Organophosphate and carbamate pesticides are anticholinesterase compounds which act directly or indirectly as cholinesterase inhibitors. When overexposure to these pesticides inhibits the cholinesterase, acetylcholine, the substance responsible for transmission of nerve impulses, accumulates in the nervous system. This produces an overstimulation and subsequent blockage of nerve stimuli.

Since the effect of these pesticides is cumulative during a period of exposure, it is mandatory that all exposed individuals be monitored. The APHIS cholinesterase monitoring program will help protect employees from pesticide poisoning. The cholinesterase program will also help monitor the use and condition of personal protective equipment.

Many methods are available for determining cholinesterase inhibition. The method of analysis chosen by the Marshfield Clinic is based on the method of Gal and Routh (Clin. Chem. Acta 1957; 2:316), as performed on the Dupont aca (automated clinical analyzer) instrument. This method uses butyrylthiocholine as a substrate which is hydrolyzed by plasma cholinesterase to thiocholine. The thiocholine reacts with a colored dye, 2,6-dichlorophenol, which is then converted to a colorless form. The decrease in absorbance is measured.

The Dupont instrument tests the level of cholinesterase present in the blood serum. Blood serum cholinesterase normally reflects the inhibition by anticholinesterase compounds before others. The cholinesterase present in serum has been referred to as pseudocholinesterase (PChE) to distinguish it from true cholinesterase (AChE) of the red blood cell. Nerve cholinesterase is also found in blood plasma, pancreas, and liver and is depressed by exposure to most organophosphate and carbamate pesticides before true cholinesterase. Based on the Marshfield methods of testing, reference values have been established for the normal population. The normal ranges for males and females are:

Males: 10.1-22.1 U/mL (units per milliliter)

Females: 8.3-20 U/mL

#### 7.5.3 RESPONSIBILITY FOR ESTABLISHING THE PROGRAM

The Occupational Medical Monitoring Coordinator (OMMPC), as delegated by the senior line manager and referenced in Sections 7.2.3 and 7.2.6, will be responsible for establishing and maintaining the cholinesterase program in the field.

#### 7.5.4 HEALTH MONITORING PROGRAM

APHIS will monitor blood cholinesterase levels in employees exposed to organophosphate and carbamate program pesticides and/or other cholinesterase inhibitors.

Exposure to pesticides means bodily contact with the pesticide in either concentrated or diluted form by inhalation, oral consumption, or skin exposure. The employee is exposed as a result of mixing, applying, or reentering a treated field. It also includes supervisors and/or observers of these operations who are exposed to the drift and may be unaware of their contamination.

In order to maintain uniform testing procedures and recordkeeping practices, Marshfield will conduct all cholinesterase analyses. Exceptions to this policy must be approved in advance by the APHIS Safety and Health Manager.

**7.5.4.1 Determining Who Will be Tested.** All APHIS employees whose responsibilities include possible or potential exposure to organophosphate or carbamate pesticides are required to have their cholinesterase levels determined before assuming their duties. This requirement includes both new employees and employees transferred from other duties which excluded pesticide exposure. Marshfield's services must be utilized for all testing.

Employees with a recent history of occupational or private exposure to organophosphates or carbamates should not expose themselves to this type of pesticide for a period of 30 days prior to taking the blood test to determine their cholinesterase levels. This is necessary to establish an employee's baseline.

OMMPCs and supervisors must refer to the following chart of basic guidelines concerning frequency of cholinesterase analyses of employees within their jurisdiction. The OMMPC may use discretion on individual cases after consulting with the APHIS Safety and Health Manager. Any APHIS employee may request his/her cholinesterase level be tested at any time if he/she has been exposed to any cholinesterase inhibiting materials.

<b>If Work Is:</b>	<b>And the Exposure Is:</b>	<b>Then a Blood Sample Is Collected</b>
Annual (more than 120 days)	(a) The actual handling and application of cholinesterase inhibitors on a continuing basis either regular, intermittent, or occasional.	Before beginning work (baseline); every 60 days; more often if supervisor or USDA physician recommends.
	(b) The handling of products which may be contaminated with cholinesterase inhibitors, e.g., cut flowers, cargo, field reentry, livestock, etc., on a continuing basis either regular, intermittent, or occasional.	(1) Before beginning work; once every two years thereafter if personal protective equipment is utilized.  (2) Before beginning work (baseline); every 60 days if protective equipment is not utilized.
Seasonal (91-120 days) includes all federally hired employees, e.g.,	(a) same as "(a)" above.	Before beginning work (baseline); after 60 days; at the end of work experience.

LAs, temporaries, etc.		
	(b) same as “(b)” above	Before beginning work (baseline); at the end of work experience.
Seasonal (less than 91 days)	(a) same as “(a)” above	Before beginning work (baseline); after 60 days; at the end of work experience.
	(b) same as “(b)” above	Before beginning work (baseline); at the end of work experience.
Any of the above	Significant, e.g., employee spills or splashes undiluted pesticide into eyes or on bare skin, falls into a dip vat of pesticide, or the employee develops symptoms of pesticide exposure.	Receive testing immediately.
Any employee	Potential or possible	Every 2 years to maintain baseline.

## 7.5.5 MONITORING, REVIEWING, AND RECORDKEEPING

### 7.5.5.1 Responsibilities of Marshfield.

Analyze and interpret laboratory results of all samples received, as authorized by, and with the consulting services of the USDA Medical Officer.

Maintain a database of cholinesterase results for APHIS employees.

Make distribution of APHIS Form 29 as indicated in Section 3.

Notify by telephone or fax the Safety, Health, and Environmental Staff if a sample result indicates an abnormal result or significant drop in cholinesterase level, as specified in 7.5.5.2 of this Section.

Maintain baseline sample for each employee.

### 7.5.5.2 Interpretation of Marshfield Cholinesterase Results.

- A. Decreases of 50 percent or more from the highest (baseline) result are considered significant regardless of whether the lowest result is within the normal range (Males 10.1-22.1 U/mL; Females: 8.3-20 U/mL), i.e., if the current value is half of an earlier value, significant exposure is likely and work restriction should be considered.
- B. Single isolated results in the range of 8.0 - 10.1 U/mL are considered a borderline low, but not necessarily indicative of significant exposure. Male subjects with results in this range should be monitored more closely; but may not have a need for work restriction.

- C. Single results less than 8.0 U/mL should be considered definitely abnormal with possible work restriction limits imposed, more frequent monitoring, and inquiry made regarding symptoms (e.g., vision problems, rash, numbness, tingling, metallic taste). See Section 7.5.6 for more information on symptoms.
- D. Red blood cell cholinesterase levels tend to be more of a chronic marker reflecting exposure over a several month period, therefore confirmatory analysis may be required using red blood cell cholinesterase test.
- E. Employees should be aware that factors other than pesticide exposure may affect cholinesterase levels, such as pregnancy and a number of medications.

#### 7.5.5.3 Responsibilities of Supervisors.

Initiate all baseline and routine requests for cholinesterase testing using APHIS Form 29, as directed by their appropriate OMMPC.

Immediately hospitalize and initiate cholinesterase testing of any employee who develops toxic clinical signs or symptoms of suspected organophosphate or carbamate poisoning. If possible, an 8 milliliter blood sample should be collected immediately at the nearest medical facility and submitted with APHIS Form 29 to Marshfield for analysis. Indicate clinical signs on APHIS Form 29 and notify Marshfield that the sample is being shipped. The employee will be immediately relieved of all work involving exposure to organophosphates or carbamates. Should poisoning be confirmed, the employee will not resume duties involving exposure to organophosphate or carbamate compounds until the cholinesterase level is 80 percent of the preexposure level.

Inform physicians, hospitals, and poison control centers in areas where local APHIS employees are working with organophosphates and carbamates. The symptoms of poisoning should be made known to these facilities, since many physicians, especially those in remote areas, may not be familiar with symptoms of pesticide exposure.

#### 7.5.5.4 Responsibilities of the OMMPC.

Receive notification by telephone or fax from the Safety, Health, and Environmental Staff, if a sample shows an abnormal result or significant drop in cholinesterase level established by preexposure cholinesterase testing. Should this occur, the OMMPC will ensure that the employee is immediately relieved of responsibilities involving contact with organophosphate and carbamate pesticides. The OMMPC will also ensure that the employee does not resume duties involving contact with organophosphates or carbamates until another blood sample, collected within 30 days, shows that the cholinesterase level has returned to not less than 80 percent of the preexposure value.

Keep a record of cholinesterase tests for all employees served. This record will be compiled from information taken from Part 5 of APHIS Form 29, and will include names of employees, dates of tests, and test results. It is recommended that a graph record of all tests be made for each employee. Records will be maintained for a period of 5 years.

Forward Part 5 of APHIS Form 29 to the appropriate employee. If results of cholinesterase testing are not within the normal range, the OMMPC will notify the supervisor to take the required action as specified in 7.5.5.3 above.

Conduct a review to determine the reason for an employee's low cholinesterase level when notified by Marshfield or SHES that an employee's cholinesterase level is too low to be considered within that employee's normal range. Exhibit 7.4 is an example of a questionnaire that can be given to the employee to aid in this investigation. Completion of the questionnaire by the employee is voluntary. Results of the review and actions taken as a result of findings should remain on file and be available for APHIS safety and health reviews

#### 7.5.6 GENERAL SYMPTOMS

The following are three levels of organophosphate or carbamate pesticide poisoning:

**Mild Poisoning.** Individuals exposed to mild poisoning may experience one or more of the following symptoms and should be aware that more serious indications may follow:

Headache, fatigue, skin irritation, loss of appetite, dizziness, weakness, nervousness, nausea, perspiration, diarrhea, eye irritation, insomnia, thirst, restlessness, irritation of nose and throat, loss of weight, soreness of joints, and/or changes of mood.

**Moderate Poisoning.** (May be the beginning of severe symptoms.)

Nausea, trembling, muscular incoordination, excessive salivation, blurring of vision, feeling of constriction in the throat and chest, difficulty breathing, flushed or yellow skin, abdominal cramps, vomiting, diarrhea, mental confusion, twitching of muscles, weeping, excessive perspiration, profound weakness, rapid pulse, and/or coughing.

**Severe Poisoning.**

Vomiting, loss of reflexes, inability to breathe, uncontrollable muscular twitching, constriction of pupils (to pinpoint-pupils), convulsions, unconsciousness, severe secretion from respiratory tract, fever, intense thirst, and/or increased rate of breathing. If possible, treatment for suspected cases of organophosphate or carbamate poisoning should not begin until a blood sample has been obtained. Any samples drawn following treatment procedures would result in false readings. However, since the progress of such poisoning cases is rapid, do not wait for Marshfield confirmation of poisoning to begin treatment.